

**RESTRICTED**  
Security Information

# TM 9-6013

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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## RANGE DRIVE T25



DEPARTMENT OF THE ARMY

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*This manual is correct to 29 June 1953*

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## RANGE DRIVE T25

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## CHAPTER 1

### INTRODUCTION

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#### Section I. GENERAL

##### 1. Scope

*a.* This manual is published for the information and guidance of personnel responsible for field and depot maintenance of range drive T25. It does not contain information which is intended primarily for the using organization, since such information is available to ordnance maintenance personnel in the pertinent operator's technical manual or field manual.

*b.* This manual contains a description of and procedures for inspection, disassembly, repair and rebuild, and assembly of the range drive T25.

*c.* The appendix contains a list of current references, including supply manuals, technical manuals, and other available publications applicable to the materiel.

*d.* Operation, lubrication, and all maintenance operations allocated to using organizations in performing maintenance work within their scope for the range drive T25 are contained in TM 9-718B.

*e.* This first edition is being published in advance of complete technical review of all concerned. Any errors or omissions will be brought to the attention of Chief of Ordnance, Washington 25, D. C., ATTENTION: ORDFM-Pub.

##### 2. Field and Depot Maintenance Allocation

The publication of instructions for complete disassembly and rebuild is not to be construed as authority for the performance by field maintenance units of those functions which are restricted to depots and arsenals. In general, the prescribed maintenance responsibilities will apply as reflected in the allocation of maintenance parts listed in the appropriate columns of Department of the Army Supply Manuals ORD 8 SNL F-377 and tools listed in ORD 6 SNL F-272. Instructions for depot maintenance are to

be used by maintenance companies in the field only when the tactical situation makes the repair functions imperative. Provisions of parts listed in the depot stock guide column of ORD 8 SNL F-377 will be made to field maintenance only when the emergency nature of the maintenance to be performed has been certified by a responsible officer of the requisitioning organization.

### 3. Forms, Records, and Reports

*a. General.* Responsibility for the proper execution of forms, records, and reports rests upon the officers of all units maintaining this equipment. However, the value of accurate records must be fully appreciated by all persons responsible for their compilation, maintenance, and use. Records, reports, and authorized forms are normally utilized to indicate the type, quantity, and condition of material to be inspected, to be repaired, or to be used in repair. Properly executed forms convey authorization and serve as records for repair or replacement of material in the hands of troops and for delivery of material requiring further repair to ordnance shops in arsenals, depots, etc. The forms, records, and reports establish the work required, the progress of the work within the shops, and the status of the material upon completion of its repair.

*b. Authorized Forms.* The forms generally applicable to units maintaining this material are listed in the appendix. For a complete listing of all forms, refer to current SR 310-20-6. For instructions on the use of these forms, refer to FM 9-10. Additional forms applicable to the using personnel are listed in the operator's manual.

*c. Field Reports of Accidents.* The reports necessary to comply with the requirements of the Army safety programs are prescribed in detail in the SR 385-10-40 series of special regulations. These reports are required whenever accidents involving injury to personnel or damage to material occur.

*d. Report of Unsatisfactory Equipment or Materials.* Any suggestions for improvement in design and maintenance of equipment and spare parts, safety and efficiency of operation, or pertaining to the application of prescribed lubricants and/or preserving materials, or technical inaccuracies noted in Department of the Army publications will be reported through technical channels, as prescribed in SR 700-45-5, to the Chief of Ordnance, Washington 25, D.C., ATTN: ORDFM, using DA Form 468, Unsatisfactory Equipment Report. Such suggestions are encouraged so that other organizations may benefit.

*Note.* Do not report all failures that occur. Report only REPEATED or RECURRENT failures which indicate unsatisfactory design or material. See also SR 700-45-5 and the printed instructions on DA Form 468.



## Section II. DESCRIPTION AND DATA

### 4. Description

a. The range drive T25 (fig. 1) serves as a member of the fire control system of the 90-mm gun tank T48 to provide means for adjusting the elevation of the weapon for range and type of ammunition. The range drive is mounted to the turret roof and consists of a manually operated turning mechanism, a series of range scales, a pair of lamps for illuminating the range scales, an output shaft, and a mounting bracket.

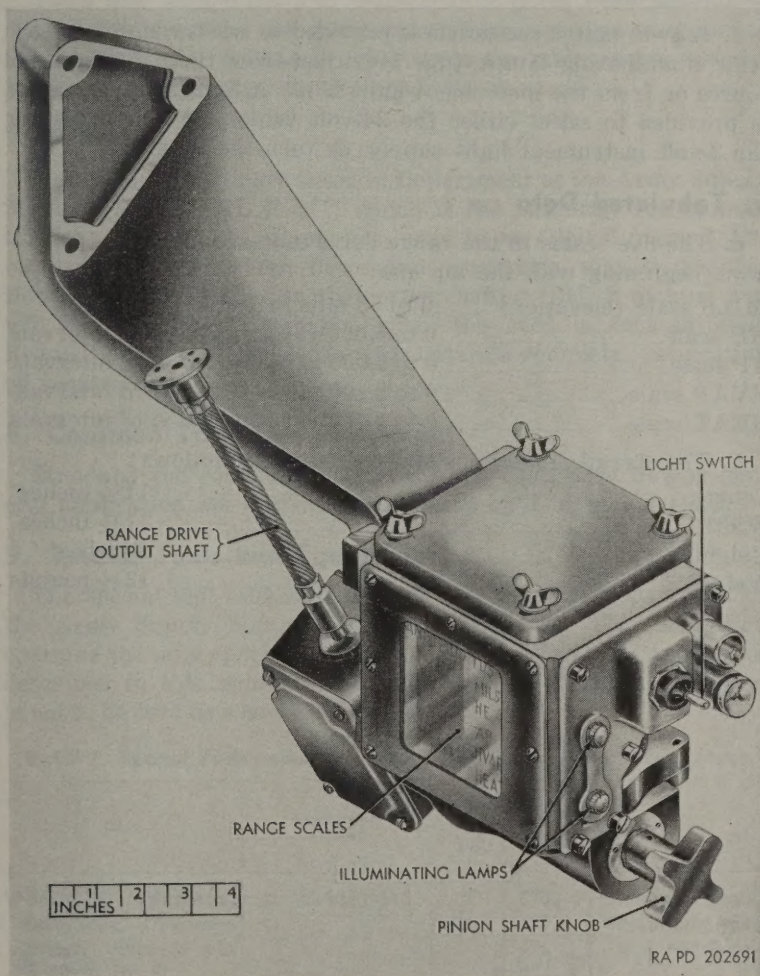


Figure 1. Range Drive T25.

b. Five range scales (fig. 1) are mounted inside the range unit. The bottom four scales are graduated in yards for four different types of ammunition. The top scale is graduated in mils and indicates the elevation required for the range indicated on either of the four bottom scales. The scales are viewed through a glass window on the left side of the range unit and are read with reference to an index etched on the range scale index.

c. The pinion shaft knob on the range unit turns the scales and also turns the range drive output shaft (fig. 1), which transmits the superelevation required for the particular range and ammunition being used.

d. A twin power receptacle is provided to receive power for the scale illuminating lamps (fig. 1) either from the vehicle power source or from the instrument light M30. A light switch (fig. 1) is provided to select either the 24-volt vehicle power supply, or the 3-volt instrument light supply, or turn the illumination off.

## 5. Tabulated Data

a. The five scales in the range drive unit are graduated as follows, beginning with the top one:

MILS scale (elevation)	0 to 63 mils in 1-mil intervals
HE scale	0 to 5,000 yards in 200-yard intervals
AP scale	0 to 5,000 yards in 200-yard intervals
HVAP scale	0 to 3,400 yards in 200-yard intervals
HEAT scale	0 to 4,400 yards in 200-yard intervals

b. The overall dimensions and weight are as follows:

Length	11½ inches
Width	11½ inches
Height	8 inches
Weight	13½ pounds



## CHAPTER 2

# PARTS, SPECIAL TOOLS, AND EQUIPMENT FOR FIELD AND DEPOT MAINTENANCE

### 6. General

Tools and equipment and maintenance parts over and above those available to the using organization are supplied to ordnance field maintenance units and depot shops for maintaining, repairing, and for rebuilding the materiel.

### 7. Parts

Maintenance parts are listed in Department of the Army Supply Manual ORD 8 SNL F-377, which is the authority for requisitioning replacements. Parts not listed in an ORD 8 manual, but required by depot shops in rebuild operations, may be requisitioned from the listing in the corresponding ORD 9 manual and will be supplied if available, when the need is substantiated. Requisitions for ORD 9 parts will contain a complete justification of requirements.

### 8. Common Tools and Equipment

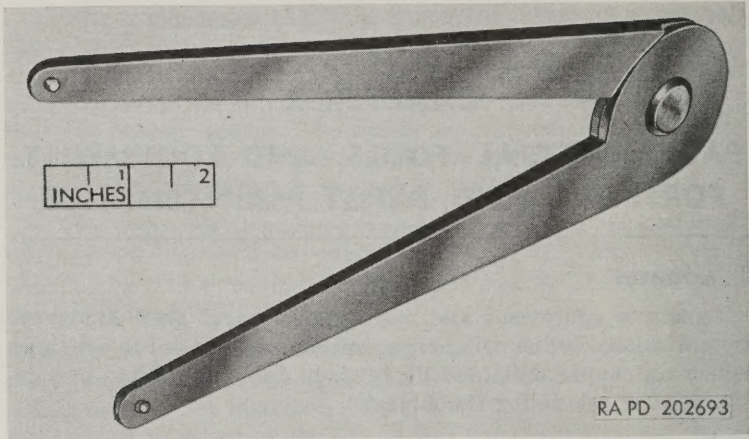
Standard and commonly used tools and equipment having general application are authorized for issue by T/A and T/O&E.

### 9. Special Tools and Equipment

The special tool tabulated in table I is listed in Department of the Army Supply Manual ORD 6 SNL F-272. This tabulation contains the only special tool necessary to perform the operations described in this manual, is included for information only, and is not to be used as a basis for requisitions.

*Table 1. Special Tools and Equipment for Field and Depot Maintenance*

Item	Identifying number	References		Use
		Fig.	Par.	
WRENCH, spanner, face, adj, Ordnance design, diam of pin 0.039 in, No. 2.	41-W-3248-110	2 4	37b, c, 42b, 47i, 52d, g	Remove or install retaining rings and adapters.



*Figure 2. Spanner wrench—41-W-3248-110.*

## CHAPTER 3

### INSPECTION

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#### Section I. GENERAL

#### 10. Scope

This chapter provides specific instructions for the technical inspections by ordnance maintenance personnel of range drive T25 either in the hands of troops or when received for repair in ordnance shops. It also defines the in-process inspection of material during repair and rebuild and the final inspection after repair and rebuild has been completed.

#### 11. Purposes of Inspection

Inspection is primarily for the purpose of (1) determining the condition of an item, i.e., serviceable or unserviceable, (2) recognizing conditions which would cause failure, (3) assuring proper application of maintenance policies at prescribed levels, and (4) determining the ability of a unit to accomplish its maintenance and supply missions.

#### 12. Categories of Technical Inspections

In general, there are five categories of inspection performed by ordnance maintenance personnel:

*a. Overall Inspection.* This is an overall inspection performed periodically on *all* materiel in the hands of troops. It is also performed on materiel received for repair in field or depot maintenance shops. Upon completion of an inspection for serviceability, materiel will be declared either serviceable or unserviceable. This inspection may be limited in scope, such as an inspection of materiel in the hands of troops, or detailed in scope, such as an ordnance shop inspection. Detailed procedures are presented in paragraphs 14 through 16.

*b. Pre-Embarkation Inspection.* This inspection is performed on materiel in the hands of troops alerted for oversea duty to insure that such materiel will not become unserviceable or worn out in a relatively short time. It prescribes a higher percentage of remaining usable life in serviceable materiel to meet a specific need beyond minimum serviceability.



*c. In-Process Inspection.* This inspection is performed by the repair technician and/or floor inspector in the process of repairing or rebuilding the materiel and its components. It insures that all parts conform to prescribed standards, that the workmanship is in accordance with approved methods and procedures, and that deficiencies not disclosed by the technical inspection are found and corrected. Detailed instructions are contained in chapter 5.

*d. Final Inspection.* This is an acceptance inspection performed by a final inspector, after repair and rebuild has been completed, to insure that the materiel is acceptable according to established standards. Detailed instructions are contained in chapter 6.

*e. Spot-Check Inspection.* This is a periodic overall inspection performed on only a percentage of the materiel in each unit to determine the adequacy and effectiveness of organizational and field maintenance.

### 13. Classification of Materiel

All ordnance materiel after inspection is classified as indicated in *a* and *b* below.

*a. Serviceable.* Serviceable property consists of all new or used supplies which are in condition for issue for the purpose intended and all supplies which can be placed in such condition through pre-issue tests or inspections, in-storage deprocessing, installation of accessories, correction of minor deficiencies which have developed since the item was last classified as serviceable, application of modification work orders for which parts are available, or assembly of available components.

*b. Unserviceable.* Unserviceable property consists of all supplies which are not serviceable (*a* above). The definition of unserviceable property is further broken down into the following subclassifications: property that is unserviceable but economically repairable and property that is unserviceable and not economically repairable.

## Section II. INSPECTION OF RANGE DRIVE T25 IN THE HANDS OF TROOPS

### 14. General

This section provides specific instructions for the technical inspection by ordnance maintenance personnel of range drive T25 in the hands of troops. Also, this section amplifies the general instructions contained in TM 9-1100 insofar as the instructions pertain to inspection of range drive T25. Personnel making these

inspections will acquaint themselves with the malfunctions indicated in paragraph 22, which are the most common deficiencies of the range drive. In general, if the range drive is complete and performs its intended function properly, if all modification work orders classified as urgent have been completed, and if all defects as disclosed by the inspection have been corrected, the range drive T25 may be considered serviceable.

## 15. Forms and Reports

Authorized forms and reports for technical inspections are prescribed in TM 9-1100. For additional authorized forms and reports for field and depot maintenance, see paragraph 3.

## 16. Inspection

*a. Completeness and Appearance.* Check for completeness and general appearance. The appearance of the range drive will indicate its general condition and will reflect the type of treatment it has received.

### *b. Functioning of Mechanical Components.*

- (1) Turn the knob slowly. The movement should be smooth and even over the entire range.
- (2) Check the coupling and the fitting on the flexible shaft for slippage or looseness.
- (3) Rotate the knob to 25- and 50-mil values as read on the range mil scale. This will produce an angular change at the coupling of 1,800 (5 complete turns) and 3,601 (10 complete turns) degrees respectively with plus or minus 7 degrees or approximately one-sixteenth inch plus or minus, on the periphery of the coupling.
- (4) The zero graduations on all range scales should coincide with each other.

*Note.* Alinement with index line is not important.

*c. Modification Work Orders.* All urgent modifications must have been applied. Check on application of all authorized modifications to see that no unauthorized alterations have been made, or that work beyond the authorized scope of the unit is being attempted. At this printing, no modification work orders have been issued; however, also check the index in SR 310-20-4 and the current modification work order files for any modification work orders promulgated subsequent to this printing.

*d. Identification Plate, Scales, and Indexes.* The engraved lines, numbers, and indexes should be clear and distinct.

*e. Paint and Finish.* The painted surfaces should not have bare spots, scratches deep enough to expose bare metal, chipped or loose paint. There will be no signs of corrosion.

*f. Lubrication.* All movable parts will be clean, properly lubricated, and free from rust and other foreign matter.

*g. Cracks or Breaks.* Check for any cracked castings or welds. Also check for cracked or broken window.

*h. Mounting Surfaces.* The mounting surface of the support should be free from paint, nicks, and burs.

*i. Illumination.* With the scales illuminated, the scale graduations should appear clearly defined when observed in a dark room.

### Section III. ORDNANCE SHOP INSPECTION

#### 17. General

Technical inspection performed by the ordnance repair shop on receipt of materiel turned in for repair, determines the extent of repairs required, and provides the basis for requisitioning the parts, assemblies, or supplies necessary to accomplish the repairs. Often this inspection in the shop may be the same as that performed by inspectors in the field. It may disclose additional necessary repairs not indicated by the using organization. See TM 9-2602 and FM 9-10 for additional information on inspections.

#### 18. Inspection

When the materiel is turned in for repair, the inspections performed will be the same as those performed in the hands of troops and will consist of—(1) checking to see that the malfunctions indicated when the range drive was inspected in the hands of troops are correct, (2) determining any additional defects not determined at the time the range drive was inspected in the hands of troops by performing the inspections indicated in paragraphs 57 through 59.

### Section IV. PRE-EMBARKATION INSPECTION

#### 19. General

Inspection for outward appearance of the range drive T25 is of importance as well as inspection of mechanical condition. Where any doubt exists as to the utility of an assembly or of the range drive, that assembly or the range drive must be replaced by a truly serviceable item. Equipment, when inspected, must approach new



equipment standards of operation and appearance, and the workmanship and quality of the end product must reflect the highest standards obtainable. To assure that all items, insofar as practicable, possess original appearance, it is desired that items normally painted be repainted if the painted surfaces show signs of damage.

## 20. Inspection

*a. General.* The specifications, standards, and operations intended as a guide to insure satisfactory performance and acceptability of the range drive T25 are indicated in paragraphs 14 through 16.

*b. Modification Work Orders.* All modifications indicated in paragraph 16 other than those designated as optional must have been applied. For those modifications not yet accomplished, requisitions will be submitted to the appropriate agency for the necessary material to be forwarded to the unit when available.

## CHAPTER 4

### TROUBLE SHOOTING

#### 21. Purpose

Trouble shooting is the systematic isolation of defective components by means of symptoms, tests to determine the defective components, and application of remedies. The scope of the level of ordnance maintenance will govern the tests and remedies which may be applied.

#### 22. Procedure

The trouble shooting procedure outlined in table II is one of determining, upon occurrence of malfunctions noted, the probable cause, then taking the necessary corrective action.

*Table II. Trouble Shooting*

Malfunction	Probable causes	Corrective action
Lamps fail to light-----	Lamp burned out-----	Replace lamp.
	No voltage from power supply.	Check incoming voltage.
	Open circuit-----	Check all connections on back of lamp cover, and check toggle switch.
	Resistor burned out-----	Install new resistor (par. 47).
Slippage at output shaft .	Loss of set screw at splined connection.	Install new set screw (par. 55).
	Loose coupling-----	Tighten coupling screws (par. 56).
Excessive backlash-----	Worn gears or pinions--	Install new gears or pinions (par. 46c, 46h, 52b).
Zero graduations on range scales do not coincide.	Slot on range scale worn--	Replace range scale (par. 46k).

## CHAPTER 5

### REPAIR AND REBUILD

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#### Section I. GENERAL MAINTENANCE

#### 23. General

*a.* Information and instructions herein are supplementary to instructions for the using organization in TM 9-718B.

*b.* This chapter contains general and specific maintenance instructions for the repair and rebuild of each major component. In paragraphs 32 through 59 specific adjustments, repair and rebuild procedures are described in order to restore each major component to a serviceable condition.

#### 24. General Methods

*a. Tools.* Use only wrenches and screwdrivers that fit snugly on parts. Tools that do not fit will fail or cause damage to the slots or corners of bolt heads, nuts, screws, etc.

*b. Handling of Disassembled Parts.* A parts tray or suitable receptacle should be provided so that parts, as removed, can be placed in their respective positions in relation to the assembled range drive T25. Large assemblies should be placed on a clean, dry, work bench and carefully placed to prevent loss or breakage. Always keep the relative position of parts until the range drive is completely assembled. This is especially important where the materiel is assembled by a technician other than the one who disassembled it. When parts are to remain disassembled for any length of time, keep bare metal surfaces clean and free from rust. Clean these surfaces with dry-cleaning solvent or volatile mineral spirits, wipe dry, and apply a light film of aircraft instruments lubricating oil. Before assembling the parts, remove this oil film with solvent.

*c. Scribing Metal Parts.* As each part is removed, its exact position in relation to the assembly should be established by suitably scribed reference marks if it is necessary to return it to its exact original position. Never scribe marks on threads or bearing surfaces. When removing mating gears, scribe each gear and assemble in the same position.



*d. Removal of Burs.* Burs should be removed with a stone or fine file. Where burs are apparent on closely fitted mating surfaces, they can be removed by lapping the surfaces with abrasive grade pumice. If burs appear on threaded surfaces, go over the damaged threads with a thread chaser.

*e. Removal of Corrosion or Rust.* All metal parts should be inspected for corrosion or rust. If corrosion or rust is found, the part should be polished immediately with crocus cloth and coated with a light film of aircraft instruments lubricating oil.

## 25. Removal of Set Screws

*a. General.* Mechanical components are frequently locked in position by the use of set screws. Disassembly of components without removing these set screws is one of the greatest causes of damage to fire control instruments. It is therefore necessary, before the removal of any parts of the range drive, to determine the presence of set screws by reference to the pertinent disassembly instructions and illustrations.

*b. Removal of Undamaged Set Screws.* When a set screw is to be removed, it may be necessary to dig out or scrape off dirt or covering paint. A sharpened piece of hard wood or brass wire are good tools for this purpose. Do not use a jewelers' screwdriver, as this action may damage both the screwdriver blade and the threads in the screw hole. When the head of the screw can be seen, insert a screwdriver of the proper size and remove the screw.

*c. Precautions.* If the screw will not back out when normal pressure is applied with the screwdriver, do not force it. It may have been sealed in position with shellac or another fixing agent. If so, apply a few drops of alcohol to the screw head and allow it to soak for a few minutes. Again insert the screwdriver and exert a slight back and forth pressure. Repeat this process until the screw can be removed by normal pressure.

### *d. Removal of Damaged Set Screws.*

- (1) If the slot of a set screw below the surface is damaged, the best method, usually, is to drill out the screw and tap the hole for the next larger size screw. If this is to be done, set up the part to be drilled in a firm position on a drill press, with the drill parallel to the set screw, and carefully drill out the screw. It is good practice to use the tap drill of the next larger screw that is to be used as a replacement. If the screw is not too small, it may be possible to drill a small hole in it and remove it with a screw extractor. If the set screw is near the surface, it may be possible to slot it sufficiently with a screw-head

file, thus saving time that would be spent in drilling and tapping.

- (2) A set screw that can be turned, but which does not back out, indicates a stripped thread condition. It may be possible to back out the screw, if the part held in place by the set screw can be turned enough to put slight stress on it, thus allowing those threads still undamaged to engage. It may then be possible to work the screw out of the hole.

## 26. Drilling and Tapping of Parts for Set Screws

Drilling and tapping of parts for screw holes is sometimes necessary when adjusting a part. Drill and tap size must be determined by checking the dimensions of the screw in ORD 9 SNL F-377. Whenever a hole is drilled and tapped, remove all burs and chips from the parts before final assembly. When drilling a shallow seating hole for a securing screw, use a drill slightly smaller than the inside diameter of the screw hole. Do not drill clear through the part in which the screw seat is being made. Just a touch of the drill will be sufficient. When the threads in the screw hole are damaged, tap with the proper sized tap.

## 27. Taper Pins

*a. Removal of Taper Pins.* To remove a taper pin, determine which is the smaller of the two ends. Usually, the larger end is identified by a "0" mark. Mark the external part at the large end, if it is not already so marked. Then remove the pin by one of the methods described in (1) and (2) below.

- (1) If the small end of the pin is exposed, one sharp blow on that end of the pin with a soft hammer is all that is usually necessary.
- (2) If the small end of the pin is below the surface, select a punch slightly smaller than that end. Use a straight pin punch, not a tapered one. Be sure to place the punch against the small end of the pin. Strike the punch with one sharp hammer blow. Such a blow will usually remove the pin, whereas several haphazardly struck blows will damage it. Determine the size of the hammer according to the size of the job.

*b. Installation of Taper Pins.* Before securing two parts with a taper pin, always check the direction of the taper. Slip the pin loosely in the hole from either side. It should be driven into the side in which it enters more deeply. Failure to follow the practice of checking the direction of taper in the parts may cause damage

to the parts when the pin is driven in, and possibly make them unserviceable. A clean hole and a well-machined pin should fit together within one-sixteenth inch of the final position. If this is not the case, check the pin for burs and the hole for poor alignment of parts. When the pin is in place properly, one sharp tap on the pin with a brass hammer is all that is needed to drive it into its final position. If a brass hammer is not available, an ordinary hammer and brass punch may be used.

*c. Preparation of New Parts to Receive Taper Pins.* A new part that is to be assembled to a shaft with a taper pin is drilled and reamed for the taper pin at assembly. The new part is already spotted to indicate the location where the part should be drilled prior to reaming. Several parts also have a tapped hole to accommodate a set screw, which can hold the part in its proper location on the shaft, during the drilling and reaming operations. After drilling and reaming, the set screws must be removed. The size of the reamer used is chosen in accordance with the size of the taper pin.

## 28. Refilling Scale Graduations

Any scale or index that has become illegible should be cleaned and filled with graduation filler. To apply graduation filler, remove all paint or filler from the perforations or graduations with a scribe or other appropriate tool. Be sure that all the edges are left sharp and distinct. Apply the filler by pressing it into the perforations or graduations with the fingers and wipe off the excess filler with a clean cloth. Care must be taken to see that the color will match the original color used for the range drive.

## 29. General Precautions in Cleaning

Volatile mineral spirits and dry-cleaning solvent are inflammable and should not be used near an open flame. Fire extinguishers should be provided when these materials are used. Use only in well ventilated places. In addition, they evaporate quickly and have a drying effect on the skin. If used without gloves, they may cause cracks in the skin and, in the case of some persons, a mild skin irritation or inflammation. The use of Diesel fuel oil, gasoline, or benzene (benzol) for cleaning is prohibited. Avoid getting petroleum products, such as dry-cleaning solvent or volatile mineral spirits on rubber parts, as the petroleum product will deteriorate the rubber.

## 30. Lubrication

*a. General.* Lubrication of the range drive should be performed very carefully as even a very slight amount of over lubrication



often will render an item unfit for use. Excess lubricant may congeal and render close fitting parts inoperative. Lubricants for the range drive function also as rust preventives. It is important that they be applied carefully. It is essential that all parts to be lubricated be cleaned thoroughly prior to the application of the lubricant, as corrosion may develop under grease if all foreign matter has not been removed.

*b. Grease.* All parts of the range drive for which grease has been recommended (retaining-ring washers) will be lubricated with aircraft and instruments lubricating grease at the time of assembly.

*c. Oil.* All parts of the range drive requiring oil (ball bearings) will be lubricated with aircraft instruments lubricating oil at the time of assembly.

## **31. Painting**

Paint all exposed surfaces so that the equipment will have the appearance of a new item. See TM 9-2851 for detailed information on painting.

# **Section II. REMOVAL AND DISASSEMBLY**

## **32. General**

Organizational maintenance in TM 9-718B covers preventive maintenance services, care in handling, lubrication and cleaning of mechanical parts, cleaning of electrical parts, organizational spare parts, tools and equipment, serviceability tests and equipment, and serviceability tests pertinent to organizational maintenance. This section covers removal from on-carriage position and complete disassembly of range drive T25.

## **33. Removal of Range Drive T25 From On-Carriage Position**

The unit is removed from its assembled position by removing the four screws in the coupling between the flexible output shaft and its companion member, and then unbolting the mounting support bracket from the tank.

## **34. Removal of Output Shaft**

Remove the set screw (fig. 3) from the shaft and pull the shaft from its splined engagement with its driving shaft.

## **35. Removal of Support**

Remove the three fillister-head screws and lock washers (fig. 3) and pull the support from the housing.

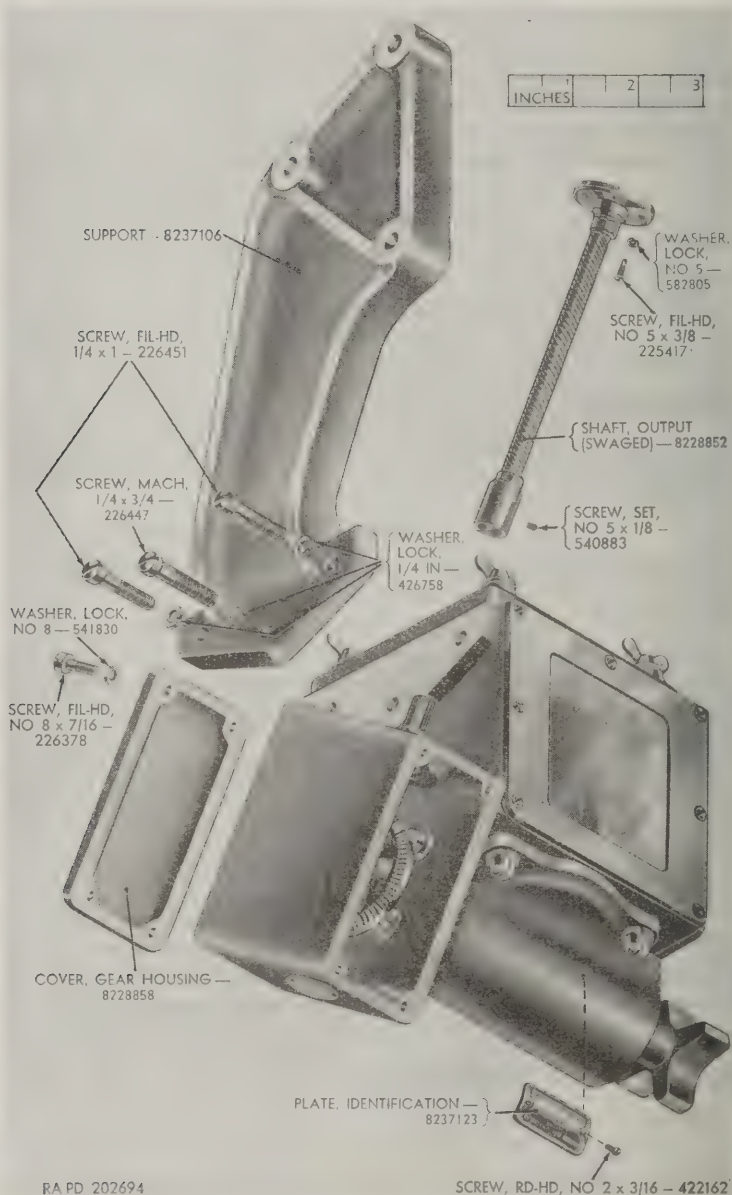


Figure 3. Range drive T25—partial exploded view.

### 36. Removal of Identification Plate

Unscrew the two round-head screws (fig. 3) and remove the identification plate.

### 37. Removal of Gear Housing and Associated Parts

a. Remove the two gear housing covers (fig. 3) by removing the four screws and lock washers by which each cover is attached to the housing.

b. Unscrew the upper retaining ring, using spanner wrench 41-W-3248-110 (fig. 4). Remove the felt washer (fig. 5) from the ring. Before unscrewing the retaining ring, first remove the set screw (fig. 5) that is inserted through the side of the housing.

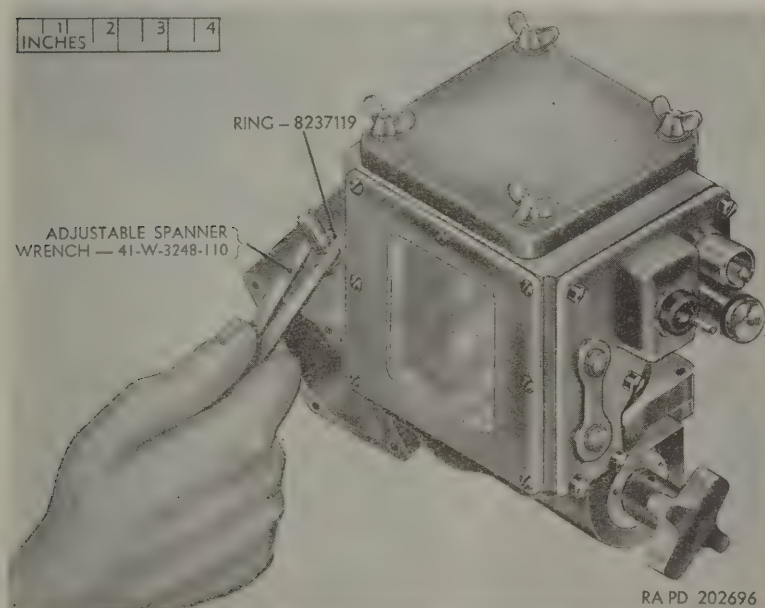


Figure 4. Removal of upper retaining ring from gear housing.

c. Unstake and unscrew the solid ring at the lower side of the housing, using spanner wrench 41-W-3248-110, to expose the lower end of the pinion shaft.

d. The shaft and its pinion are then removed by tapping the lower end of the shaft. Contact between the upper ball bearing and its snap ring will remove this bearing along with the shaft. The pinion (fig. 5) can then be removed from the shaft by driving out its taper pin. Remove the upper ball bearing from the shaft and the lower ball bearing from the housing. Pry the snap rings from the shaft.

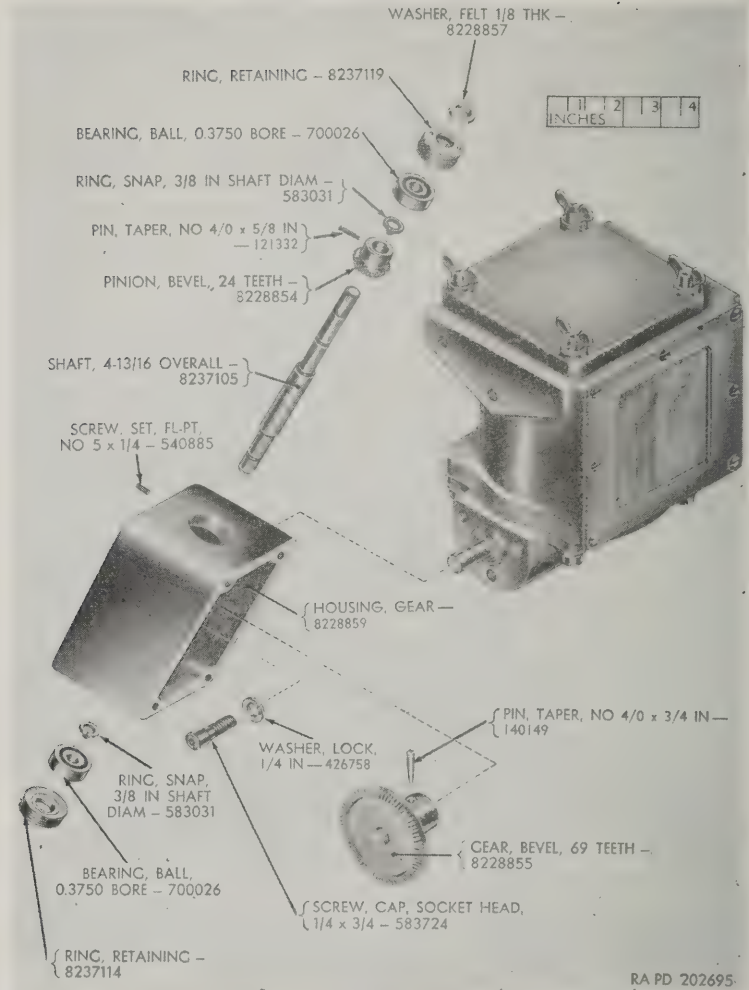


Figure 5. Range drive T25—partial exploded view.

e. Remove the gear (fig. 5) from the end of the drive shaft after driving the taper pin from the gear.

f. Using an offset screwdriver, remove the three screws and lock washers that attach the gear housing to the base.

### 38. Removal of Housing Cover Assembly

Unscrew the four thumbscrews sufficiently to permit removal of the cover assembly (fig. 6). These screws are provided with



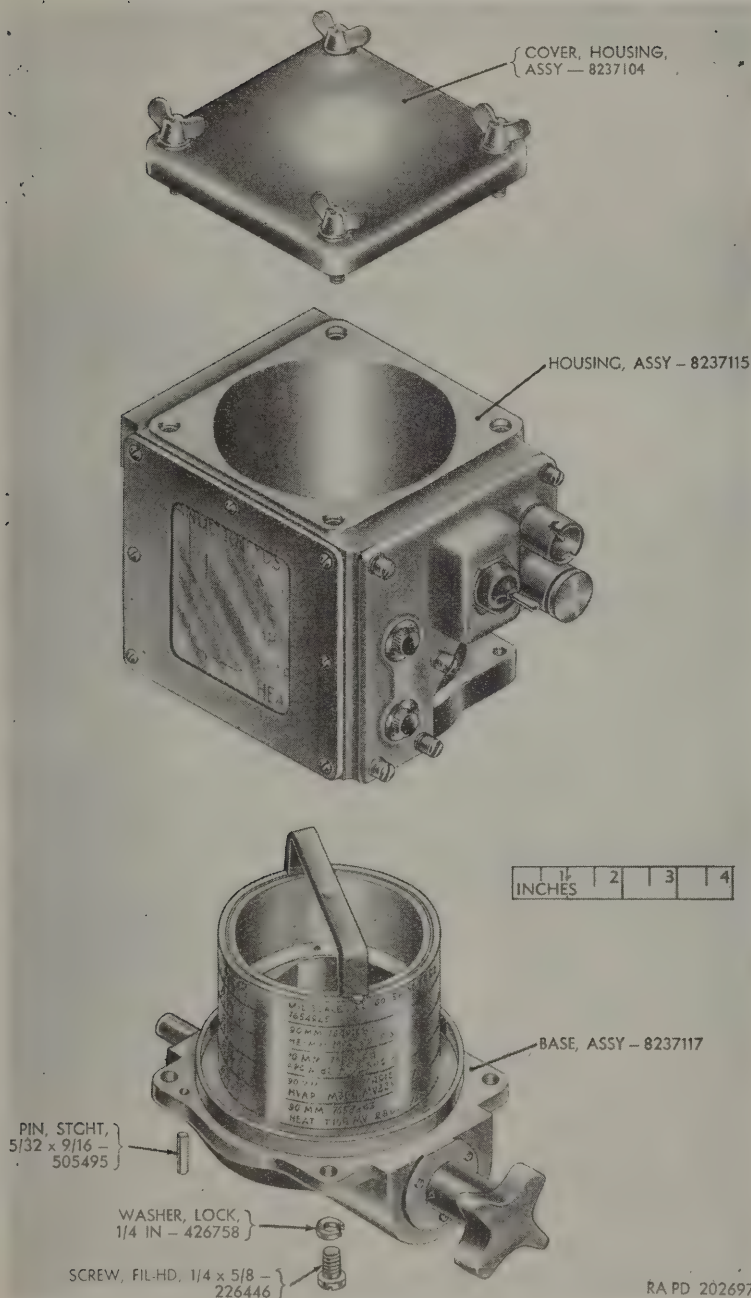


Figure 6. Range drive T25—partial exploded view.

retaining rings to prevent unintentional removal of the screws from the cover.

### 39. Removal of Base Assembly From Housing Assembly

The base assembly (fig. 6) is removed from the housing assembly by removing the four attaching screws and lock washers. Drive the two locating dowel pins from the base assembly.

### 40. Disassembly of Housing Cover Assembly

Remove the thumbscrews and their washers (fig. 7) from the cover by releasing the retaining rings from the inner side. Lift the gasket out of the groove in the inner surface.

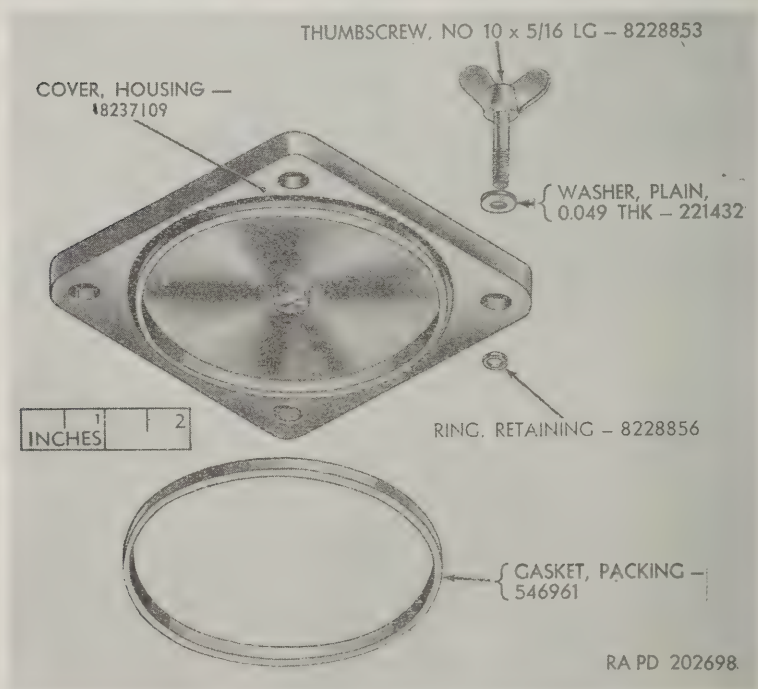
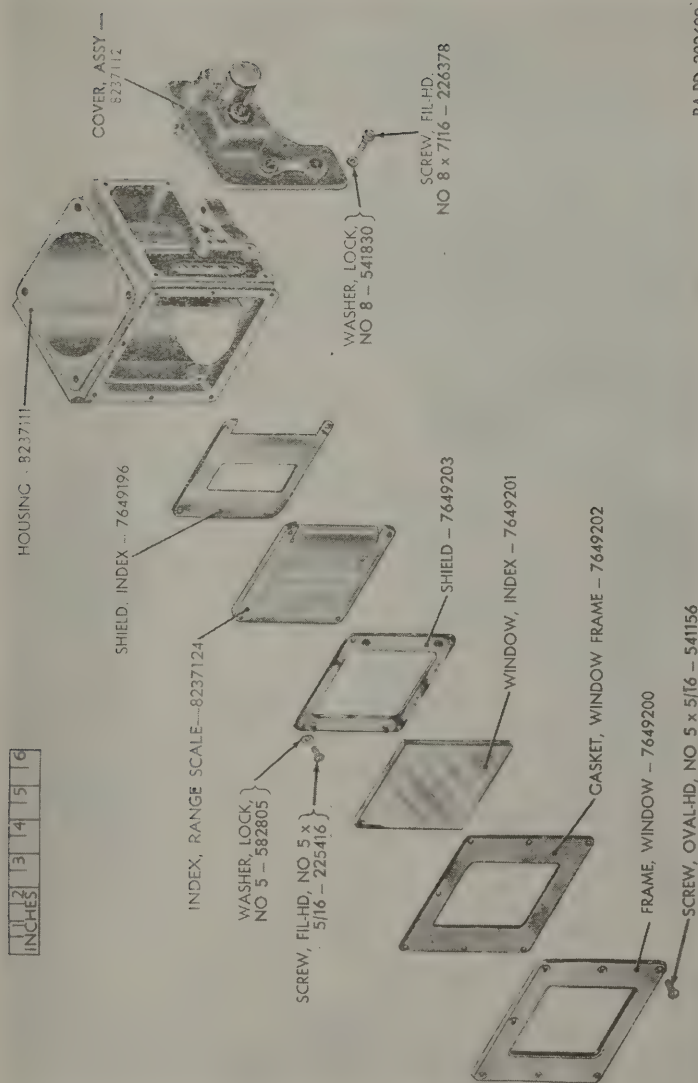


Figure 7. Cover assembly 8237104—exploded view.

### 41. Disassembly of Housing Assembly

a. Unscrew the six screws and lock washers (fig. 8) that secure the cover assembly to the housing and remove the cover assembly.

b. Unscrew the seven screws fastening the window frame to the housing. Remove the window frame, gasket, and window.



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Figure 8. Housing assembly 8237115—exploded view.

c. Remove the four screws and lock washers securing the index to the housing. Remove the outer shield, index, and inner shield.

## 42. Disassembly of Cover Assembly

a. Remove the lamps (fig. 9) by unscrewing them from the cover.

b. Unscrew the adapters with spanner wrench 41-W-3248-110 and remove the washers, rings, and wires associated with the lamps. Unsolder the wires at the terminals of the switch at the rear of the cover.

c. Remove the contact and banana plugs (fig. 9) and their washers by unscrewing the terminal nuts (fig. 10) from the back of the cover and withdrawing the plugs and washers from the front side. A terminal and insulating washer (fig. 10) are removed when the nut is unscrewed. Access to the lower (3-volt) plug is gained by pulling out the safety plug (fig. 9).

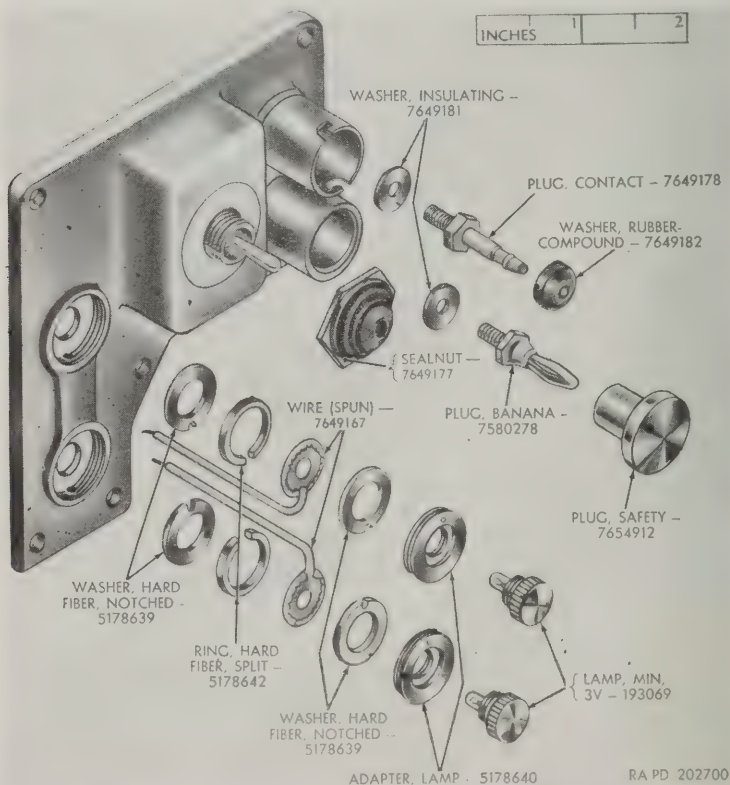


Figure 9. Cover assembly 8237112—partial exploded view.



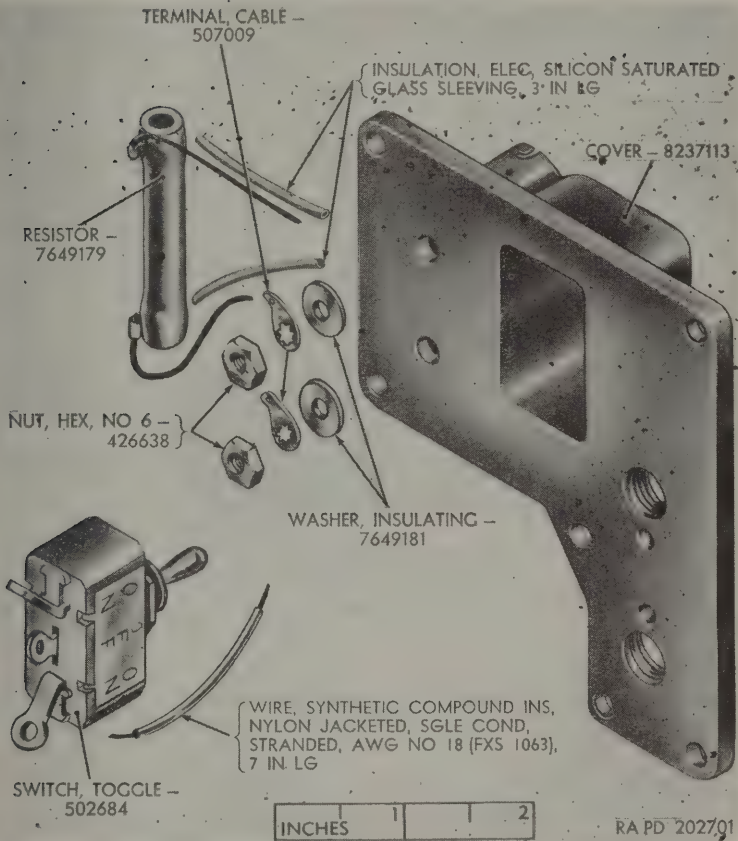


Figure 10. Cover assembly 8237112—partial exploded view.

d. Remove the toggle switch (fig. 10) from the rear of the cover, after unscrewing the sealnut (fig. 9) from the front side. Unsolder all connections to the switch.

e. Unsolder connections to the resistor and remove the resistor (fig. 10).

### 43. Disassembly of Base Assembly

a. Lift the ejector and its nested scales (fig. 11) free from the assembly. The scales are then removed from the ejector by pinching together the lower ends of the ejector.

b. Release the threads of the retaining ring (fig. 12) by removing the locking screw and lock washers. Unscrew the ring from the base.

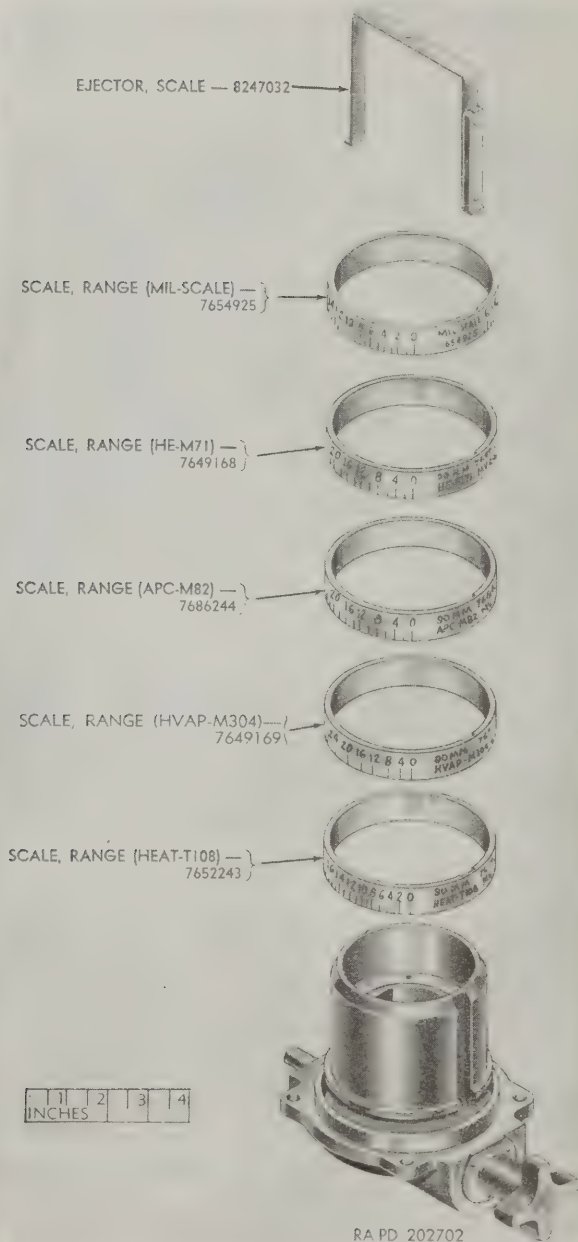


Figure 11. Base assembly 8237117—partial exploded view.

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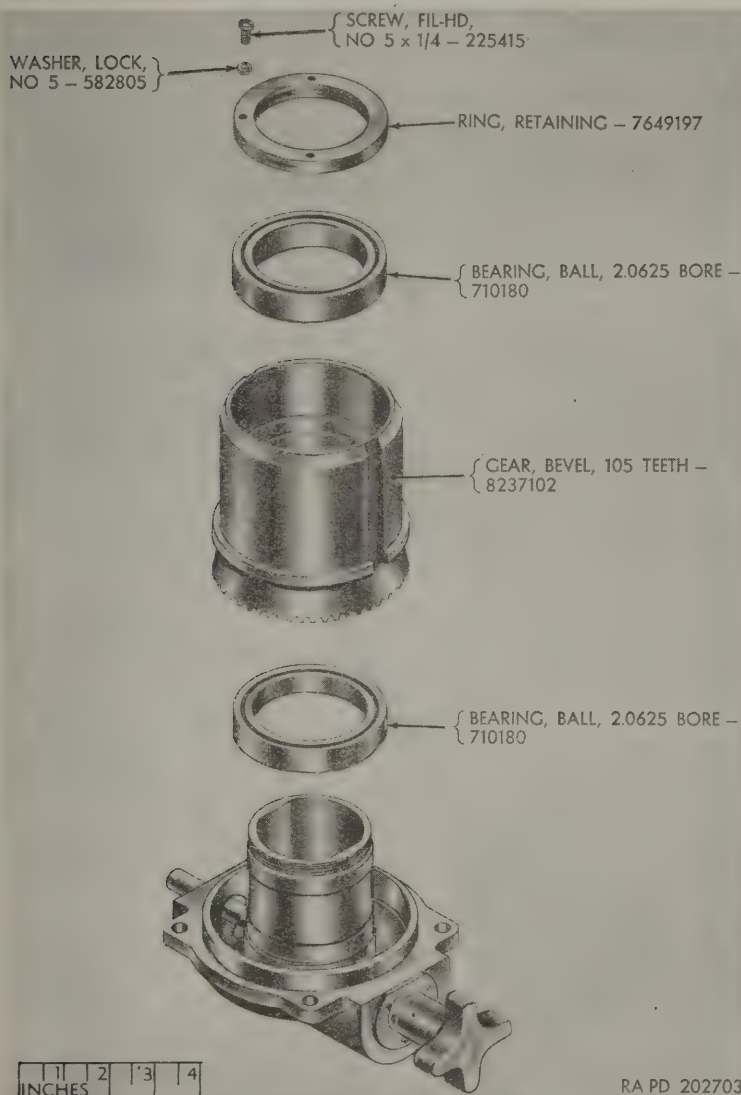


Figure 12. Base assembly 8237117—partial exploded view.

c. Lift the gear (fig. 12) vertically out of the assembly. The upper ball bearing will be withdrawn with the gear. The lower ball bearing can then be withdrawn from the base.

d. Remove the snap ring (fig. 13) from the end of the shaft.

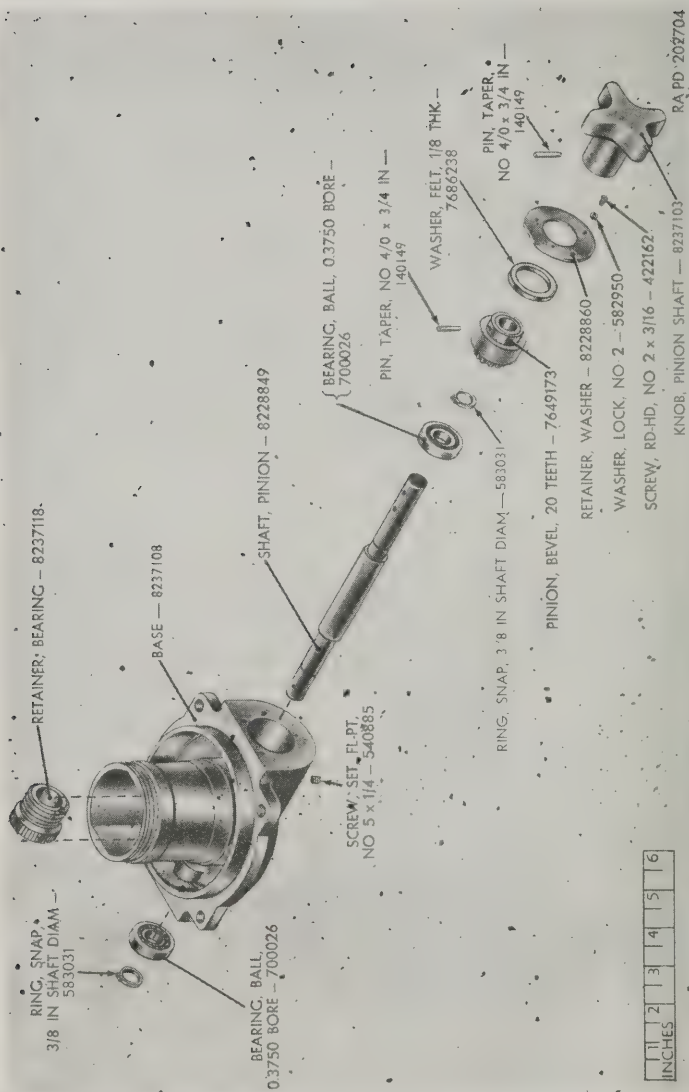


Figure 13. Base assembly 8237117—partial exploded view.



*e.* Remove the set screw from the lower side of the base. Then reach inside the base and unscrew the inner bearing retainer, letting it lie free on the shaft.

*f.* Drive the taper pin from the knob and withdraw the knob from the shaft.

*g.* Remove the three screws and lock washers (fig. 13) from the retainer at the knob end and remove the retainer.

*h.* The shaft with its inner bearing and its pinion and grease-impregnated washer can now be removed by tapping on the end opposite the knob end. The bearing retainer can now be removed from the base.

*i.* To remove the pinion (fig. 13) from the shaft, drive out the taper pin and pull the pinion off the shaft.

*j.* To remove the inner bearing, pry off the snap ring and pull the bearing from the shaft.

*k.* Remove the other bearing from its position in the base.

### Section III. REBUILD, ASSEMBLY, AND INSTALLATION

#### 44. General

This section covers complete rebuild of individual components and of assemblies, in-process inspection, assembly, and installation of the range drive T25.

#### 45. Rebuild

All instructions contained in paragraphs 23 through 31 should be observed in rebuilding the range drive T25. Be certain that all parts are serviceable, as indicated in *a* through *f* below, before proceeding with assembly.

*a.* Inspect all threaded portions of the range drive for stripped or burred threads. Go over any damaged threads with a thread chaser.

*b.* Inspect all gaskets for dryness, cracks, and tears. Replace any damaged gasket.

*c.* Inspect all parts for burs. Remove burs with a fine stone (par. 24*d*).

*d.* Examine all parts of the range drive for dents. Remove dents or, if they cannot be removed, replace the part.

*e.* Check all moving parts for wear. If any part is worn excessively, it must be replaced.

*f.* Check all painted portions of the range drive for chipped paint. If the paint is chipped, repaint with the proper authorized finish (par. 31).

## 46. Assembly of Base Assembly

a. Lubricate the end 0.3750-inch bore ball bearing (fig. 13) with aircraft instruments lubricating oil and insert it against the recessed shoulder in the base.

b. Lubricate the inner 0.3750-inch bore ball bearing with aircraft instruments lubricating oil and slide it on the pinion shaft. Insert the  $\frac{3}{8}$ -inch shaft-diameter snap ring on the shaft to hold the bearing in place.

c. Slide the 20-tooth bevel pinion on the pinion shaft and secure it with the No. 4/0 x  $\frac{3}{4}$  taper pin (par. 27b).

d. Lower the inner bearing retainer (fig. 13) into the base and screw it a few turns into place. Then insert the shaft, with its inner ball bearing, snap ring, and pinion in place, into the base. Push it far enough in to permit assembly of the  $\frac{3}{8}$ -inch shaft-diameter snap ring for the end ball bearing. With this snap ring in place, move the shaft back until the ring makes light contact with the inner race of the bearing, meanwhile, making sure that the outer race is against its shoulder in the base.

e. Screw the inner bearing retainer up tight, and lock it by means of the No. 5 x  $\frac{1}{4}$  flat-point set screw, which is inserted through a hole on the underside of the base.

f. Insert the grease-impregnated  $\frac{1}{8}$ -inch thick felt washer in its place between the pinion and the base, and then install the outside washer retainer to the base and secure by means of the three No. 2 lock washers and No. 2 x  $\frac{3}{16}$  round-head screws.

g. Slide the pinion shaft knob (fig. 13) on the shaft and secure it with a No. 4 x  $\frac{3}{4}$  taper pin.

h. Lubricate the low 2.0625-inch bore ball bearing (fig. 12) with aircraft instruments lubricating oil and slide it on the base. Then slide the 105-tooth bevel gear onto the base.

i. Lubricate the upper 2.0625-inch bore ball bearing (fig. 12) with aircraft instruments lubricating oil and slide onto the base until it seats in the bevel gear. Secure the bearings and gear to the base by screwing the retaining ring on the base.

j. Lock the retaining ring in position with the No. 5 lock washer and No. 5 x  $\frac{1}{4}$  fillister-head screw.

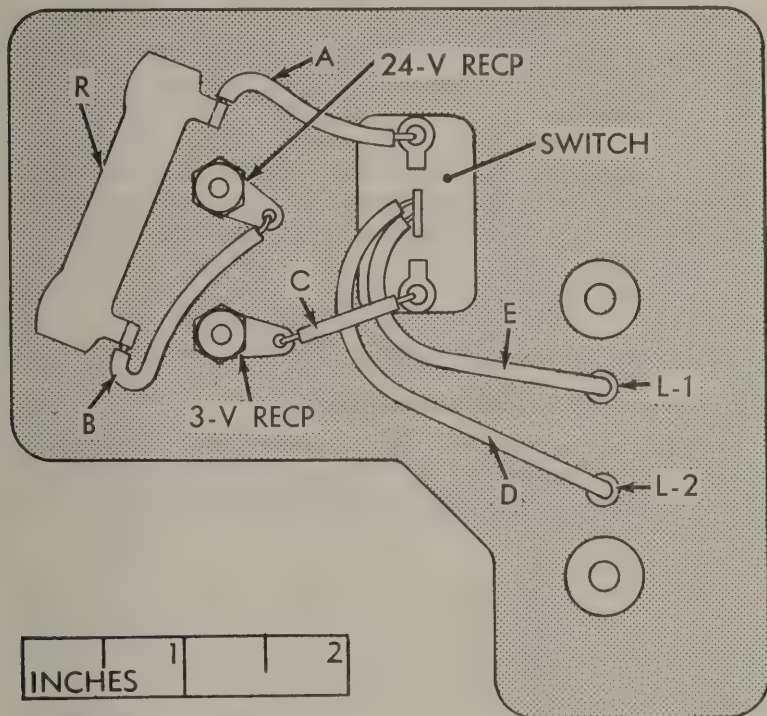
k. Examine the graduations on the scales for legibility. Refill the graduations if necessary (par. 28). Place the five range scales (fig. 11) in position on the scale ejector by squeezing the lower ends of the ejector together slightly. The slots in each scale should engage the key on one leg of the ejector.

l. Lower the ejector and scales down over the gear until the legs of the ejector engage the slots in the gear.

## 47. Assembly of Cover Assembly

a. Using an ohmmeter, check the resistance of the resistor. The resistance should be 60 ohms.

b. Solder a cable terminal (fig. 10) to one of the leads of the resistor "R" (fig. 14).



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Figure 14. Back view of cover assembly 8237112.

c. Check the toggle switch for continuity, using an ohmmeter. There should be continuity between the center terminal and either of the outside terminals.

d. Insert the toggle switch (fig. 10) in the cover and secure it with the sealnut (fig. 9).

e. Solder the free lead (A, fig. 14) of the resistor to the upper terminal of the toggle switch.

f. Cement the rubber-compound washer to the hex-shoulder of the contact plug (fig. 9). Assemble the insulating washer and the contact plug in the upper receptacle. Assemble another insulating washer (fig. 10) on the rear end of the plug and attach

the terminal lead (B, fig. 14) of the resistor to the plug by means of the No. 6 hex nut (fig. 10).

*g.* Solder a cable terminal to one end of the short length of No. 18 AWG wire (C, fig. 14) and solder the other end to the lower terminal of the toggle switch.

*h.* Assemble an insulating washer and the banana plug (fig. 9) in the lower receptacle. Assemble another insulating washer on the rear end of the plug and attach the terminal end of the short length of No. 18 AWG wire (fig. 10) to the plug by means of the No. 6 hex nut.

*i.* Assemble the notched hard-fiber washer, the split hard-fiber ring, the spun wire, and the second notched hard-fiber washer (fig. 9) in each of two lamp receptacles on the front of the cover and secure them with the lamp adapters, using spanner wrench 41-W-3248-110. Screw the two 3-volt miniature lamps in place.

*j.* In assembling the two spun wires (E and D, fig. 14), they should be inserted through the small inclined holes in the receptacles. Solder the ends to the middle terminal of the toggle switch.

#### 48. Assembly of Housing Assembly

*a.* Wipe the range scale index with a clean cloth. Examine the lettering and index line and refill if necessary (par. 28). Assemble the index shield, range scale index, and outer shield (fig. 8), and secure them with the four No. 5 lock washers and No. 5 x  $\frac{5}{16}$  fillister-head screws.

*b.* Wipe the index window with a clean cloth or tissue paper, and replace if it is cracked or pitted. Assemble the index window, window frame gasket, and window frame and fasten them in place with the seven No. 5 x  $\frac{5}{16}$  oval-head screws (fig. 8).

*c.* Examine the rear face of the cover assembly to see that the white surface in the vicinity of the lamp receptacles is clean and unmarred. See that all soldered connections are secure. At the front of the cover, see that the upper plug receptacle is securely soldered in place. In the housing, examine the glass segment to see that it is clean and securely sealed in place. Assemble the cover assembly to the housing (fig. 8) with the six No. 8 lock washers and No. 8 x  $\frac{7}{16}$  fillister-head screws.

#### 49. Assembly of Housing Cover Assembly

*a.* Clean the groove in the inner surface of the housing cover and insert an undamaged packing gasket (fig. 7) in the groove.

*b.* Place the 0.049-inch thick plain washers in position and insert the four No. 10 x  $\frac{5}{16}$  long thumbscrews in the cover. Apply the retaining rings to the screws on the inner side.



## 50. Installation of Base Assembly on Housing Assembly

a. Clean the joint surfaces, and place the base assembly (fig. 6) in position with the knob end under the lamp cover assembly and insert the two  $\frac{5}{32} \times \frac{9}{16}$  straight pins.

b. Secure the base by means of the four  $\frac{1}{4}$ -inch lock washers and  $\frac{1}{4} \times \frac{5}{8}$  fillister-head screws.

## 51. Installation of Housing Cover Assembly

Clean the joining surfaces and screw the cover assembly (fig. 6) in place on the housing assembly by means of the four thumb-screws.

## 52. Installation of Gear Housing and Associated Parts

a. Clean the joining surfaces and attach the gear housing (fig. 5) to the base assembly by means of the three  $\frac{1}{4}$ -inch lock washers and  $\frac{1}{4} \times \frac{3}{4}$  socket-head cap screws, using an offset screwdriver.

b. Place the 69-tooth bevel gear over the end of the shaft with its pin hole alined with the hole in the shaft. Drive the gear onto the shaft until the pinholes line up, and secure with the No. 4 x  $\frac{3}{4}$  taper pin (par. 27b).

c. Lubricate the lower 0.3750-inch bore ball bearing (fig. 5) with aircraft instruments lubricating oil and insert it in place in the lower bore in the housing by tapping lightly on its outer race (par. 30).

d. Screw the lower (solid) retaining ring in position against its shoulder by means of spanner wrench 41-W-3248-110.

e. Prepare the  $4\frac{13}{16}$ -inch overall shaft (fig. 5) for installation as follows: Assemble the  $\frac{3}{8}$ -inch shaft-diameter snap ring in the groove at its lower end. Assemble the 24-tooth bevel pinion on the shaft and secure it by its No. 4/0 x  $\frac{5}{8}$  taper pin. Assemble the other  $\frac{3}{8}$ -inch shaft-diameter snap ring in its groove just above the pinion. Lubricate the upper 0.3750-inch bore ball bearing with aircraft instruments lubricating oil and slide it on the  $4\frac{13}{16}$ -inch overall shaft in contact with the snap ring.

f. Insert the assembled shaft into the gear housing through the upper opening and slide its lower end into the lower ball bearing until the snap ring makes light contact with the inner race of the bearing, meanwhile, making sure that the outer race is down against its retaining ring. The outer race of the upper bearing should also be tapped lightly as it enters its bore.

g. Insert the grease-impregnated  $\frac{1}{8}$ -inch thick felt washer (fig. 5) in its groove in the upper retaining ring and screw the ring up tight with spanner wrench 41-W-3248-110. Lock it by means of

the No. 5 x  $\frac{1}{4}$  flat-point set screw, which is inserted through the side of the housing.

*h.* Turn the shaft by hand to see that it moves freely, and then stake the lower (solid) retaining ring to the housing.

*i.* Clean the joining surfaces and attach the two gear housing covers (fig. 3) to the housing with the four No. 8 lock washers and No. 8 x  $\frac{7}{16}$  fillister-head screws provided for each cover.

### 53. Installation of Identification Plate

Attach the identification plate (fig. 3) to the base assembly by means of the two No. 2 x  $\frac{3}{16}$  round-head screws.

### 54. Installation of Support

Clean the joining surfaces and attach the support (fig. 3) to the housing with the three  $\frac{1}{4}$ -inch lock washers and  $\frac{1}{4}$ -inch fillister-head screws; the two upper screws are 1-inch long and the lower one is  $\frac{3}{4}$ -inch long.

### 55. Installation of Output Shaft

Push the output shaft (fig. 3) into its splined engagement with the driving shaft and secure it with the No. 5 x  $\frac{1}{8}$  set screw.

### 56. Installation of Range Drive T25 to On-Carriage Position

Clean the joining surface of the support bracket and its companion surface in the tank and secure the bracket in place with its three mounting bolts. Attach the coupling of the flexible output shaft to the coupling of the ballistic drive T24 with four No. 5 x  $\frac{3}{8}$  fillister-head screws and No. 5 lock washers.

## Section IV. TESTS AND ADJUSTMENTS

### 57. General

The tests and adjustments in paragraphs 58 and 59 are performed after the range drive has been completely assembled. No fixtures are required for these tests.

### 58. Backlash

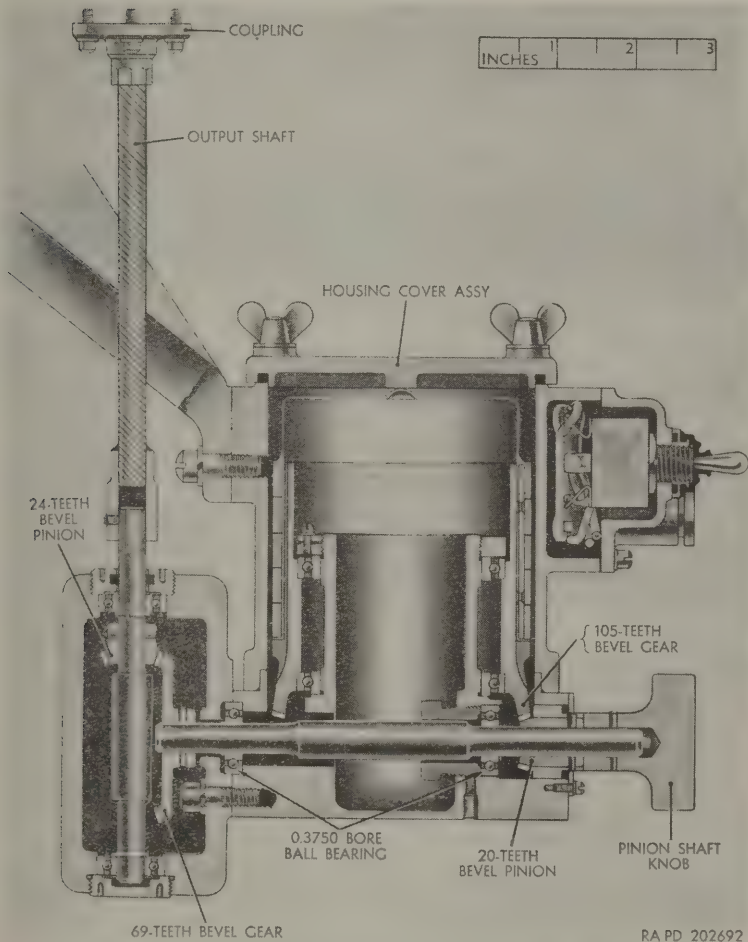
*a. Inspection.* Set the range drive on a suitable stand so that the mounting surface is in a vertical position.

*Note.* Accurate positioning in this respect is not important.

- (1) Rotate the pinion shaft knob (fig. 15) to 25- and 50-mil values as read on the range mil scale. This should pro-

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duce an angular change at the coupling of 1,800 (5 turns) and 3,601 (10 turns), respectively, plus or minus  $7^\circ$  or approximately one-sixteenth inch on the periphery of the coupling.



*Figure 15. Range drive T25—sectionalized view.*

- (2) With the housing cover assembly (fig. 15) removed and the 105-tooth bevel gear held rigidly, the backlash as measured at the coupling should not exceed  $3^\circ$  or approximately one thirty-second inch on the periphery of the coupling.

*b. Adjustment.* Backlash, if excessive, is caused by worn bevel gears or bevel pinions (fig. 15). To correct for backlash, it will be necessary to inspect the gears and pinions and replace any that are worn excessively. Check as in *a* above after replacement is made.

## 59. Movements

*a. Inspection.* Test the turning torque of the pinion shaft knob (fig. 15) by applying a force by means of standard weights or a spring balance to a cord wound around the knob. The force required to rotate the knob should not exceed 3 inch-pounds torque.

*b. Adjustment.* If the knob does not turn freely, the 0.3750-inch bore ball bearings (fig. 15) must be cleaned or, if damaged, must be replaced. Binding of the bevel gears with the bevel pinions might also cause difficulty in turning the knob.



## CHAPTER 6

### FINAL INSPECTION

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#### 60. General

Final inspection is performed after repair and rebuild has been completed to insure that the materiel is serviceable according to established serviceability standards. It includes a general visual inspection of the range drive for proper assembly and a functional check to make sure that the range drive is functioning properly.

#### 61. Inspection

*a.* Turn the knob slowly. The movement should be smooth and even over the entire range.

*b.* Check the coupling and the fitting on the flexible shaft for slippage or looseness.

*c.* Rotate the knob to 25- and 50-mil values as read on the range mil scale. This will produce an angular change at the coupling of 1,800 (5 complete turns) and  $3,601^{\circ}$  (10 complete turns), respectively, with plus or minus  $7^{\circ}$  or approximately one-sixteenth inch plus or minus on the periphery of the coupling.

*d.* The zero graduations on all range scales should coincide with each other.

*Note.* Alinement with index line is not important.

*e.* The engraved lines, numbers, and indexes should be clear and distinct.

*f.* The painted surfaces should not have bare spots, scratches deep enough to expose bare metal, chipped or loose paint. There will be no signs of corrosion.

*g.* Check for cracked or broken window.

*h.* The mounting surface of the support should be free from paint, nicks, and burs.

*i.* With the scales illuminated, the scale graduations should appear clearly defined when observed in a dark room.

## APPENDIX

### REFERENCES

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#### 1. Publication Indexes

Special Regulations in the 310-20 series, SR 110-1-1, ORD 1, FM 21-8, and SB 9-1 should be consulted frequently for latest changes or revision of references given in this appendix and for new publications relating to materiel covered in this manual.

#### 2. Supply Manuals

The following Department of the Army Supply Manuals pertain to this materiel:

<i>a. Destruction to Prevent Enemy Use.</i>	
Land Mines and Components; Demolition Explosives and Related Items; and Ammunition for Simulated Artillery, Booby Trap, Hand Grenade, and Land Mine Fire.	ORD 3 SNL R-7
<i>b. Repair and Rebuild.</i>	
Cleaners, Preservatives, Lubricants, Recoil Fluids, Special Oils, and Related Maintenance Materials.	ORD 3 SNL K-1
Items of Soldering, Metallizing, Brazing, and Welding Materials; Gases and Related Items.	ORD 3 SNL K-2
Lubricating Equipment, Accessories, and Related Dispensers.	ORD (*) SNL K-3
Lubricating Fittings, Oil Filters, and Oil Filter Elements.	ORD 5 SNL H-16
Fire Control Major Items and Major Combinations for Use With Small Arms, Automatic Guns, Mortars, and Field Artillery.	ORD 3 SNL F-1
Miscellaneous Hardware -----	ORD 5 SNL H-2
Standard Hardware -----	ORD 5 SNL H-1
Tool Set, Fire Control Repairman	ORD 6 SNL J-10, Sec 13
Tool Set, Instrument Repairman (MOS 3922)	ORD 6 SNL J-10, Sec 14

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\* See ORD 1 for published manuals of the Department of the Army Supply Manual.

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Tool Sets for Maintenance of Sighting and Fire Control Equipment. ORD 6 SNL F-272<sup>1</sup>

### *c. Sighting and Fire Control Equipment.*

Drive, Range, T25----- ORD (\*) SNL F-377

## 3. Forms

The following forms pertain to this materiel:

DA Form 9-71, Locator and Inventory Control Card  
DA Form 9-72, Ordnance Stock Record Card  
DA Form 9-76, Request for Work Order  
DA Form 9-77, Job Order Register  
WD AGO Form 9-78, Job Order  
DA Form 9-79, Parts Requisition  
DA Form 9-80, Job Order File  
WD AGO Form 9-81, Exchange Part or Unit Identification Tag  
DA Form 446, Issue Slip  
DA Form 447, Turn-in-Slip  
DA Form 468, Unsatisfactory Equipment Report  
DA Form 811, Work Request and Job Order  
DA Form 811-1, Work Request and Hand Receipt  
DA Form 828, Job Time Ticket—Individual  
WD AGO Form 829, Rejection Memorandum  
WD AGO Form 865, Work Order  
WD AGO Form 866, Consolidation of Parts  
WD AGO Form 867, Status of Modification Work Order  
DD Form 6, Report of Damaged or Improper Shipment

## 4. Other Publications

The following publications contain information pertinent to this materiel and associated equipment:

### *a. Camouflage.*

Camouflage, Basic Principles----- FM 5-20

### *b. Decontamination.*

Decontamination----- TM 3-220

Defense Against Chemical Attack----- FM 21-40

### *c. Destruction to Prevent Enemy Use.*

Explosives and Demolitions----- FM 5-25

Ordnance Service in the Field----- FM 9-5

### *d. General.*

Inspection of Ordnance Materiel in the Hands of Troops. TM 9-1100

Accident Experience—Reporting and Records\_\_\_ SR 385-10-41

Artillery Materiel and Associated Equipment----- TM 9-2300

Unsatisfactory Equipment Report----- SR 700-45-5

\* See ORD 1 for published manuals of the Department of the Army Supply Manual.

<sup>1</sup> SNL F-272 is gradually being superseded by ORD 6 SNL J-15. Check ORD 1 for inclusion of the latest publication of group J manuals.

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## *e. Operation.*

90-mm Gun Tank T48..... TM 9-718B

## *f. Repair and Rebuild.*

Abrasive Cleaning, Preserving, Sealing, Adhesive, TM 9-850  
and Related Materials Issued for Ordnance  
Materiel.

Electrical Testing Apparatus for Fire Control TM 9-1672  
Equipment.

Fire Control Materiel: Lubrication..... TB 9-2835-1

Hand, Measuring, and Power Tools..... TM 10-590

Instruction Guide: Care and Maintenance of Ball TM 37-265  
and Roller Bearings.

Instruction Guide: Elementary Optics and Applica- TM 9-2601  
tion to Fire Control Instruments.

Instruction Guide: Instrument Repairman. . . . TM 9-2602

Lubrication ..... TM 9-2835

Maintenance and Care of Hand Tools ..... TM 9-867

Maintenance Responsibilities and Shop Operation . . . AR 750-5

Modification of Ordnance Materiel . . . . . SB 9-38

Operation and Maintenance of Optical Coating TM 9-1501  
Equipment.

Ordnance Maintenance and General Supply in the FM 9-10  
Field.

Painting Instructions for Field Use ..... TM 9-2851

## *g. Shipment and Stand-By and Long-Term Storage.*

Army Shipping Document..... TM 38-705

Instruction Guide: Ordnance Packaging and Ship- TM 9-2854  
ping (Posts, Camps, and Stations).

Marking of Oversea Supply ..... SR 746-30-5

Military Standard—Marking of Shipments..... MIL-STD-129<sup>2</sup>

Ordnance Storage and Shipment Chart—Group SB 9-OSSC-F  
F.

Processing of Unboxed and Uncrated Equipment for AR 747-30  
Oversea Shipment.

Preservation, Packaging, and Packing of Military TM 38-230  
Supplies and Equipment.

Processing of Motor Vehicles and Related Unboxed Ma- SB 9-4  
teriel for Shipment and Storage.

Protection of Ordnance General Supplies in Open TB ORD 379  
Storage.

Report of Damaged or Improper Shipment..... SR 745-45-5

Standards for Oversea Shipment and Domestic TB ORD 385  
Issue of Ordnance Materiel Other than Ammu-  
nition and Army Aircraft.

<sup>2</sup> Copies may be obtained from Aberdeen Proving Ground, Aberdeen, Md.



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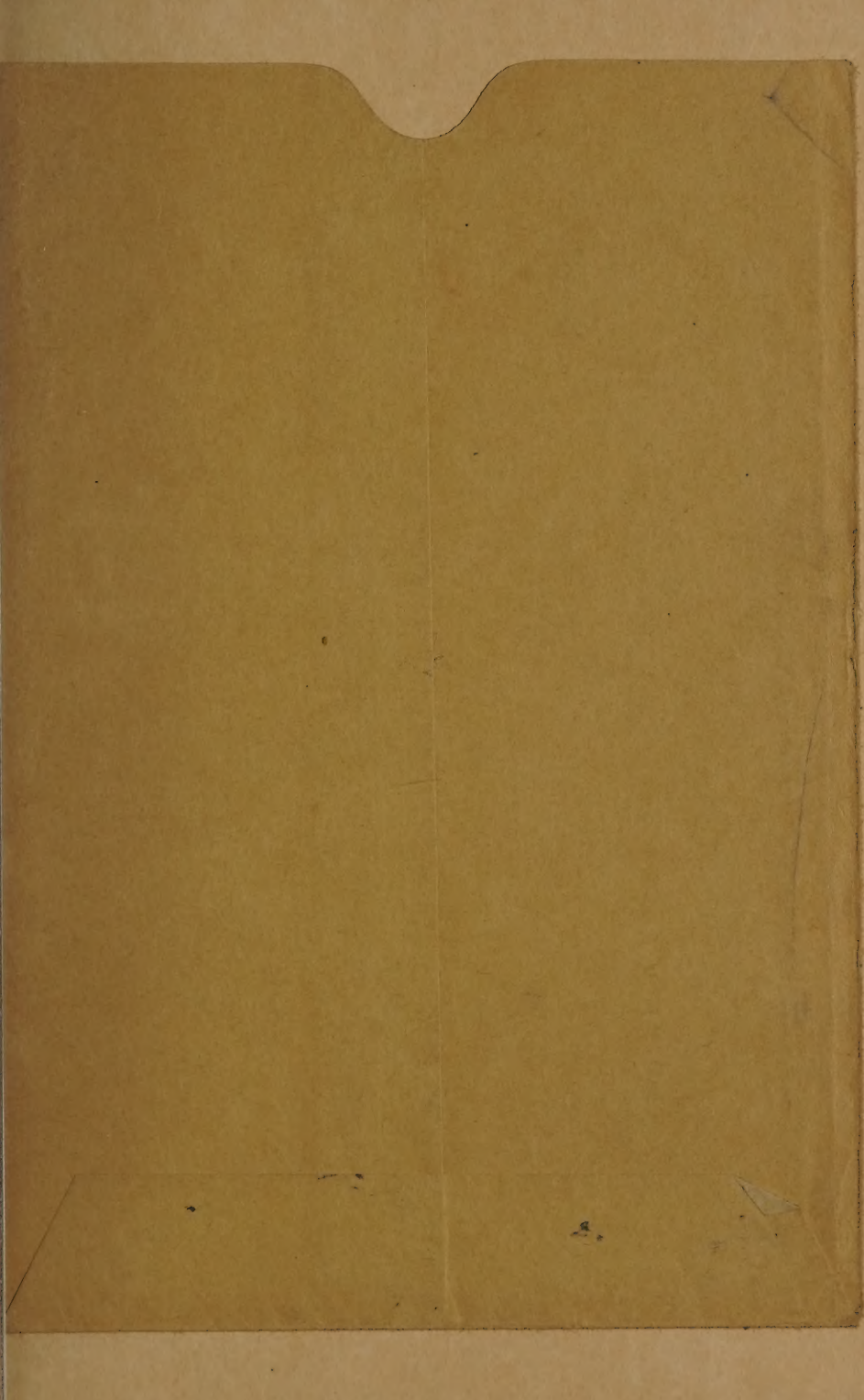
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